

Field Study

Occupational Safety and Health Measures in Micro-scale Enterprises (MSEs) in Shiraz, Iran

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Abstract: Objectives: This study aimed to determine the extent of implementation of occupational safety and health measures in micro-scale enterprises (MSEs) and to assess the prevalence of occupational injuries and accidents and its relationship with occupational safety and health measures provided in the MSEs. **Method:** A cross-sectional study was conducted among 595 of MSEs. An index called the Safety and Health Requirement Index (SHRI) was created and used to calculate the percentage of provided occupational safety and health measures. The relationship between the SHRI and the occurrence of occupational accidents and injuries was investigated with the independent samples t-test and one-way ANOVA. **Results:** The mean SHRI score was 60.43%, which was categorized into moderate level. Of the 30.9% of enterprises that had experienced accidents and injuries, the most common types of injuries were musculoskeletal disorders and cuts, and the least common types were pulmonary and hearing problems. Results of one-way ANOVA revealed a statistically significant relationship between the mean SHRI score and industrial branch, enterprise size, and type of accident and injury. The independent samples t-test showed that the occurrence of occupational accidents and injuries was not significantly influenced by provided health and safety measures in MSEs. **Conclusion:** Given the

high percentage of enterprises with very poor to poor levels for the SHRI and the high prevalence of occupational accidents and injuries among the studied MSEs, feasible protective strategies and job safety training programs are required to promote occupational health and safety in the studied MSEs.

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Introduction

Small-Scale Industries (SSIs) play a crucial role in the development of the national economy and generation of employment and self-employment of a country. According to an International Labour Organization (ILO) report⁽¹⁾, SSIs account for the majority of the world's labor force, accounting for, on average, nearly 40% of the workforce in the industrialized countries and up to 60% of the workforce in developing and newly industrialized countries.

SSIs have a number of unique characteristics when compared with large-scale enterprises. There is a great deal of evidence⁽²⁻⁶⁾ indicating that workers employed in SSIs are provided with insufficient and poor-quality occupational health and safety services and perform their duties under suboptimal working conditions. SSIs are not organized to provide workers with safety regulations and education. The lack of safety controls in SSIs along with a poor knowledge of safe practices and safety behaviors

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of workers has led to a wide range of accidents and disabling injuries in SSIs. The findings of a nationwide survey in Japan⁷⁾ showed that 72% of all occupational injury cases requiring sick leave for 4 days or more were related to the SSI sector. Furthermore, in a study conducted by Park et al.⁸⁾ among 5,080 factories in Korea, the morbidity rate due to occupational accidents and diseases in small-scale enterprises was higher than the national rate. Similarly, Okuga et al. found that 92% of Ugandan welders employed in SSIs reported injuries or illnesses that they suspected were caused by their work⁹⁾.

In Iran, industries employing fewer than 10 employees are considered as micro-scale enterprises (MSEs), which constitute more than 98% of all enterprises, and their employees account for more than 80% of the total workforce. According to Iran's labor law and social security regulations¹⁰⁾, employers with more than 25 employees are obliged to a) prepare the means and resources necessary to secure the safety, well-being, and health of the workers in their work environment and to teach them how to use them, b) perform annual health check-ups for employees and provide the results to the Iran Ministry of Health and Medical Education, and c) monitor and measure occupational harmful agents in workplaces. There are some private occupational health companies registered with the Iran Ministry of Health and Medical Education that provide occupational health services to these enterprises¹¹⁾. However, these services are very limited for MSEs, and these enterprises are not forced legally to provide occupational health and safety services. On the other hand, employees in MSEs use poor, outdated machinery and equipment and poorly designed work tools, lack suitable and adequate personal protective equipment, and perform their duties in poor working environments that include high levels of noise, poor lighting, inadequate ventilation, poor housekeeping, and inadequate working space.

So far, a few studies have addressed some of the health and safety problems in Iranian MSEs. In a cross-sectional study¹²⁾ performed among small hand-woven carpet enterprises, Nazari et al. found that more than half of the carpet weavers were not satisfied with some of the health and safety aspects of their workshops, such as thermal conditions, cleanliness of the air, lighting conditions, noise level, and work station and tool design. However, there is no study in Iran that presents a clear picture of the extent of implementation of health and safety standards in MSEs, particularly taking into account the wide range of occupations. This information would be helpful to focus on occupations needing attention and planning effective programs for improving health and safety measures in Iranian MSEs. Therefore, the aims of the current study were to assess (1) the current status of health and safety measures in MSEs and (2) the prevalence of occupational injuries and accidents and its relationship with health and

safety conditions of the MSEs.

Materials and Methods

Setting and sampling

This cross-sectional study was conducted among micro-scale enterprises (those with less than 10 employees) in Shiraz, a city in one of the largest provinces of Iran, Fars province. A stratified random sampling method was used to ensure a representative sample of all enterprises. From a list of 3257 micro-scale enterprises, 703 enterprises were randomly selected depending on the distribution of enterprises by industry. The distribution of enterprises was as follows: 1422, 153, 852, 403, 119, 135, and 173 enterprises in the automobile repairs, electrical, metal, wood, construction, chemical, and food industries, respectively. Selected enterprises were visited and after informing the employers/employees about the aims of the research, the numbers of enterprises ultimately surveyed in the current study was 595 (84.63%), including 302, 13, 148, 67, 55, 8, and 2 enterprises in the automobile repair, electrical, metal, wood, construction, chemical, and food industries, respectively.

Required data on occupational safety and health measures in each MSE were collected using an audit checklist constructed based on national safety and health regulations. The checklist covered 7 dimensions (Appendix A) including fire safety (7 items), electrical safety (7 items), building safety (6 items), machinery safety (9 items), chemical safety (3 items), occupational health measures (15 items), and use of personal protective equipment (3 items). In order to create an index to calculate the percentage of provided occupational safety and health measures, items of the checklist were rated by a judging panel consisting of 10 occupational health and safety (OHS) experts from Shiraz University of Medical Sciences using the following three-point scale: 0 (fully provided occupational safety and health measures), 1 (partly provided occupational safety and health measures), and 2 (did not provide occupational safety and health measures). In the next stage, to weight the importance of each item in the checklist, a coefficient scored from 1 (minimum importance) to 3 (maximum importance) was allocated to each item by the judging panel mentioned above. For this purpose, the average score of the panellists for each item was considered for determination of the importance coefficient (IC) as follows: 1-1.5 (IC of 1), 1.6-2.5 (IC of 2), and 2.6-3 (IC of 3).

Finally, an index called the Safety and Health Requirement Index (SHRI) was created to calculate the percentage of provided occupational safety and health measures in the MSEs as follows:

$$\text{SHRI} = \frac{(\sum nx)}{(\sum 2n)} \times 100,$$

Table 1. The distribution of SMEs and other dependent variables of the studied sample (n=595)

| Characteristics | n | % |
|--|-----|------|
| <i><u>Industry branch</u></i> | | |
| Automobile repair | 302 | 50.8 |
| Electrical industry | 13 | 2.2 |
| Metal industry | 148 | 24.9 |
| Wood industry | 67 | 11.2 |
| Construction industry | 55 | 9.2 |
| Chemical industry | 8 | 1.3 |
| Food industry | 2 | 0.3 |
| <i><u>Enterprises by number of employees</u></i> | | |
| 1 to 2 employees | 493 | 82.8 |
| 3 to 5 employees | 83 | 13.9 |
| More than 5 employees | 19 | 3.2 |
| <i><u>Employees covered by insurance regulations</u></i> | | |
| Yes | 758 | 71.3 |
| No | 305 | 28.7 |
| <i><u>Accidents and injuries</u></i> | | |
| Yes | 184 | 30.9 |
| No | 411 | 69.0 |
| <i><u>Type of accidents and injuries</u></i> | | |
| Falling | 19 | 10.3 |
| Cuts | 36 | 19.6 |
| Burns | 14 | 7.6 |
| Electrical shocks | 12 | 6.5 |
| Hearing problems | 7 | 3.8 |
| Pulmonary problems | 3 | 1.6 |
| Musculoskeletal disorders | 93 | 50.5 |

where n is the IC and x is the score of each item. The SHRI was then graded with the following scale: $\leq 25\%$, very poor; 26-50%, poor; 51-75%, moderate, and $>75\%$, good. These categories were applied for judging the level of provided occupational safety and health measures in the studied MSEs. The SHRI was also used successfully in a recent study to determine the percentage of provided occupational safety and health measures in an Iranian hospital¹³⁾.

In order to check the reliability of the checklist, the internal consistency of the dimensions was measured with the Cronbach's alpha test. The study protocol was approved by the Shiraz University of Medical Sciences ethics committee, and all the participating enterprises were informed about the objectives of the study and asked to provide written consent prior to start of the study.

Statistical analysis

Statistical analysis was performed using the IBM SPSS Statistics software (version 21). Descriptive statistics were used to describe the characteristics of the study population. The relationship between the SHRI and each

dependent variable was investigated using the t-test and analysis of variance (ANOVA).

Results

Reliability test results revealed that the checklist had an acceptable internal consistency range. The relevant Cronbach's alpha coefficient was 0.90. The Cronbach's alpha coefficients for dimensions 1-7 of the checklist were within the range of 0.60-0.90, meeting the minimum acceptable value for Cronbach's alpha^{14,15)}. The Cronbach's alpha coefficients for the fire safety, electrical safety, building safety, machinery safety, chemical safety, occupational health measures and use of personal protective equipment dimensions were 0.829, 0.855, 0.648, 0.918, 0.857, 0.631, and 0.859, respectively. The distributions of MSEs and other dependent variables of the studied sample are presented in Table 1. The industry with the highest number of enterprises was the automobile repair industry (50.8%), followed by the metal (24.9%) and wood (11.2%) industries. Among the surveyed MSEs, 82.8% had 1 to 2 workers, 13.9% had 3 to 5 workers, and 3.2% had 5 to 10 workers. The majority of employers/employees (71.3%) were covered by insurance regulations. Of the 30.9% of enterprises that had experienced accidents and injuries, the most common types of injuries were musculoskeletal disorders and cuts, and the least common types were pulmonary and hearing problems.

A high level of occupational safety and health requirements may have an important role in decreasing the occurrence of accidents and injuries. Table 2 shows the relationships between the mean SHRI score and other variables. Statistically significant relationships were found between the mean SHRI score and industrial branch, enterprise size, and type of accident and injury.

The overall SHRI calculated for the studied MSEs in the current research was 60.43% (SD=20.03), which represented a moderate level. Classification of the enterprises by SHRI category revealed that 24.9%, 42.9%, 24.9%, and 5.4% of the enterprises were in the good, moderate, poor, and very poor categories, respectively (Fig. 1).

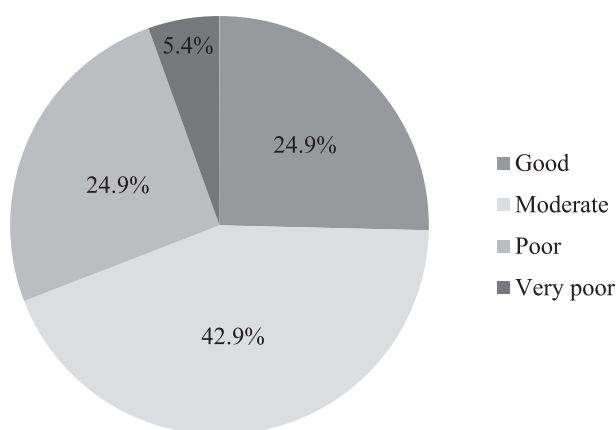
Table 3 shows the mean and standard deviation values for the SHRI and the distribution of SHRI categories for the different dimensions of health and safety measures. According to Table 3, the lowest SHRI score was related to dimensions of chemical safety (SHRI=36.42%), followed by use of personal protective equipment (SHRI=40.22%) and machinery safety (SHRI=47.37%), respectively.

Discussion

In this research, the implementation of various dimensions of health and safety measures in MSEs and its relationship with the prevalence of occupational accidents

Table 2. The relationship between mean SHRI score and dependent variables (n=595)

| Characteristics | Mean SHRI (SD) | P-value |
|---|----------------|---------|
| <i>Industry branch</i> | | |
| Automobile repair | 57.37 (19.9) | <0.001 |
| Electrical industry | 51.51 (18.43) | |
| Metal industry | 67.59 (18.85) | |
| Wood industry | 63.02 (20.03) | |
| Construction industry | 54.60 (16.94) | |
| Chemical industry | 77.14 (18.13) | |
| Food industry | 49.87 (3.71) | |
| <i>Enterprises by number of employees</i> | | |
| 1 to 2 employees | 59.67 (20.11) | 0.041 |
| 3 to 5 employees | 65.54 (18.40) | |
| 5 to 10 employees | 57.71 (22.72) | |
| <i>Employees covered by insurance regulations</i> | | |
| Yes | 60.64 (19.89) | 0.72 |
| No | 58.72 (20.20) | |
| <i>Accidents and injuries</i> | | |
| Yes | 61.75 (19.25) | 0.25 |
| No | 59.84 (20.36) | |
| <i>Type of accidents and injuries</i> | | |
| Falling | 62.95 (26.55) | <0.001 |
| cuts | 56.54 (19.15) | |
| Burns | 62.95 (26.55) | |
| Electric shock | 60.41 (16.46) | |
| Hearing problems | 60.24 (20.44) | |
| Pulmonary problems | 78.75 (18.45) | |
| Musculoskeletal disorders | 65.33 (15.47) | |

**Fig. 1.** SHRI categories of the studied MSEs (n=595)

and injuries was studied. The overall SHRI for the studied MSEs was categorized into the moderate level (SHRI=60.43%). According to our findings, the occurrence of occupational accidents and injuries was not significantly influenced by health and safety measures provided in MSEs.

Although the mean SHRI score was categorized into

the moderate level in the current research, considering the categorizations, 30.3% of the studied MSEs were at the very poor to poor level. This result is more than twofold the value reported by Dryson¹⁶⁾, who found that 15% of New Zealand workers in small industries considered their worksite occupational health services to be poor.

In this study, a statistically significant difference was found between the mean SHRI scores in enterprises with different number of employees. In the current research, the mean SHRI score was lower in enterprises with 5 to 10 employees than in enterprises with 1 to 2 or 3 to 5 employees. This result is in contrast with findings of a national study conducted among Danish industries¹⁷⁾, which showed a lower level of systematic occupational health and safety management in enterprises with 1 to 4 and 5 to 19 employees than larger enterprises. Furthermore, Fabiano et al.¹⁸⁾ analyzed the relationship between safety performance and number of employees in Italian industries during a period of 5 years using the frequency index (FI) of accidents, i.e., the number of total injuries per million hours of working

Table 3. Mean and standard deviation values for the Safety and Health Requirement Index (SHRI) and the distribution of SHRI categories for the different dimensions of health and safety measures

| Dimension | Mean of SHRI (SD) | SHRI categories N (%) | | | |
|--------------------------------------|-------------------|-----------------------|------------|------------|------------|
| | | Good | Moderate | Poor | Very poor |
| Fire safety | 65.67 (34.59) | 303 (50.9) | 117 (19.7) | 79 (13.3) | 20 (3.4) |
| Electrical safety | 54.82 (39.60) | 250 (42.0) | 55 (9.2) | 90 (15.1) | 111 (18.7) |
| Building safety | 69.25 (31.88) | 280 (47.1) | 146 (24.5) | 94 (15.8) | 31 (5.2) |
| Machinery safety | 47.37 (33.89) | 132 (22.2) | 125 (21.0) | 169 (28.4) | 35 (5.9) |
| Chemical safety | 36.42 (38.61) | 112 (18.8) | 43 (7.2) | 150 (25.2) | 10 (1.7) |
| Occupational health measures | 66.61 (19.88) | 235 (39.5) | 246 (41.3) | 89 (15.0) | 24 (4.0) |
| Use of personal protective equipment | 40.22 (39.30) | 135 (22.7) | 72 (12.1) | 137 (23.0) | 2 (0.3) |
| Total SHRI score | 60.43 (20.03) | 148 (24.9) | 255 (42.9) | 148 (24.9) | 32 (5.4) |

$$(FI = \frac{\text{Number of total injuries}}{\text{Number of worked hours}} \times 10^6).$$

The results of their study indicated a reduction in the frequency index of accidents with an increase in enterprise size, with small enterprises recording an FI higher by 47% than the FI in large enterprises. A possible reason for the difference in findings between the current study and the other studies mentioned above could be related to an unequal distribution in terms of the number of the studied enterprises. In the current study, the distribution of samples in three categories of enterprises was not identical. While enterprises with 1 to 2 and 3 to 5 employees constituted 96.7% of the sample, only 3.2% of the sample was in the category of enterprises with 5 to 10 employees, which does not allow for actual causative conclusions to be made.

According to the study results, 30.9% of enterprises reported that they had experienced occupational accidents and injuries during the previous 12 months. Some of the previous studies also reported a high prevalence of occupational accidents and injuries among SMEs. In a study conducted by Nakata et al.⁷⁾ it was found that 35.6% of Japanese small-scale manufacturing enterprises had experienced an occupational injury during the previous year. Furthermore, in the study of Park et al.⁸⁾ conducted among small-scale enterprises in Korea, the accident rate was 26.0 per 1,000 workers. Also, small companies with fewer than 10 employees had nonfatal and death rates that were two and three times those of companies with over 1,000 employees in the Korean construction industry¹⁹⁾.

The results of the present study highlighted that musculoskeletal disorders were the commonest work-related injury, which is consistent with other studies. For instance, the prevalence of musculoskeletal disorders was 78.5% among Indian workers in the small-scale garment industry²⁰⁾ and 81.17% among carpet weavers engaged in Iranian small-scale enterprises²¹⁾.

Small enterprises are not organized to fulfill the legal requirements for control of occupational health and safety hazards. In the current study, the SHRI scores for dimensions of chemical safety, use of personal protective equipment (PPE), and machinery safety were between 25 to 50%, all of which were at the poor level. This finding is in line with a previous study reporting a poor chemical and physical work environment in MSEs²²⁾. According to the results of the current research, only 17.89% of enterprises labelled chemicals based on their safety hazards, 31.05% of enterprises kept chemicals in a safe way, and 26.84% of employees were aware of the safety of chemicals (data not shown). In addition, PPE was available in 51.05% of enterprises, but only 15.26% of them used PPE when performing jobs that required its use. Similarly, Kwame et al.²³⁾ reported that a significant number of Ghanaian workers in small-scale sawmilling industries did not use PPE when operating machines or performing jobs that required their use. They concluded that insufficient supply and non-use of personal protective equipment were the cause of 45% of injuries that occurred among workers.

Some limitations must be considered in this research. First, the cross-sectional nature of the research does not allow further explanation of the casual relationship between provided safety and health measures in the studied MSEs and the occurrence of accidents and injuries. Second, the records for accidents and occupational injuries were self-reported, and it is possible that respondents would not provide correct information to the researcher via this method for a variety of reasons. Third, the distribution of samples in the three categories of enterprises was unequal, which does not allow for interpretation of real differences in SHRI scores between the enterprises of different sizes. Finally, the participation rates for enterprises in the chemical (8 out of 135) and food (2 out of 173) industries were very low. Therefore, it is difficult to say that these enterprises represent their respective industries. It is suggested that future studies should consider

Appendix A. Used checklist for measuring safety and occupational health status in the studied micro-scale enterprises

| Dimensions | Items | Provided occupational safety and health measures | | | | Important coefficient (n) | Score (nx) |
|-------------------|--|--|--------------|----------|----------------|---------------------------|------------|
| | | Yes (x=0) | Partly (x=1) | No (x=2) | Not Applicable | | |
| Fire safety | Is the enterprise equipped with fire extinguishers? | | | | | 2 | |
| | Are fire extinguishers charged? | | | | | 2 | |
| | Are fire extinguishers placed in standard and reachable areas? | | | | | 3 | |
| | Have employees been trained to operate fire extinguishers? | | | | | 2 | |
| | Are flammable liquids kept in standard vessels? | | | | | 1 | |
| | Are flammable liquids stored in dry places and far from sunlight and other ignition sources? | | | | | 3 | |
| | Are flammable wastes collected, stored, and treated appropriately? | | | | | 3 | |
| Electrical safety | Are all electrical lines insulated and supported by metal conduit? | | | | | 2 | |
| | Is the enterprise equipped with a standard electric box? | | | | | 2 | |
| | Is the electrical box equipped with a rubber pad? | | | | | 2 | |
| | Has the electrical box been grounded? | | | | | 2 | |
| | Are portable electrical lamps insulated? | | | | | 3 | |
| | Is the electrical box equipped with double insulation? | | | | | 3 | |
| | Have electrical equipment and machines been grounded? | | | | | 3 | |
| Building safety | Are walking surfaces flat and free from any obstacles? | | | | | 2 | |
| | Is the floor washable and steep? | | | | | 2 | |
| | Is the floor slippery? | | | | | 1 | |
| | Are the walls smooth and washable in plant using chemical materials? | | | | | 2 | |
| | Have safety guards and canopies been considered for the workers working outside? | | | | | 1 | |
| | Are stairs standard and safe? | | | | | 2 | |
| Machinery safety | Are the equipment and machines installed in a way that they do not cause problems for walking? | | | | | 1 | |
| | Is there enough space around each machine for repairs or materials transfer? | | | | | 1 | |
| | Are all dangerous parts of the machines equipped with standard safety guards? | | | | | 3 | |
| | Are tool holders used for holding work pieces with a specific surface area? | | | | | 2 | |
| | Do machines have manufacturer instructions? | | | | | 2 | |

Appendix A. Used checklist for measuring safety and occupational health status in the studied micro-scale enterprises (continued)

| Dimensions | Items | Provided occupational safety and health measures | | | | Important coefficient (n) | Score (nx) |
|-------------------------------|---|--|--------------|----------|----------------|---------------------------|------------|
| | | Yes (x=0) | Partly (x=1) | No (x=2) | Not Applicable | | |
| Machinery safety | Are all machines equipped with a grounding system? | | | | | 3 | |
| | Are all machines labelled by technical specifications and safety instructions? | | | | | 1 | |
| | Do workers avoid working with machines while wearing scarves, loose clothing, rings, etc? | | | | | 3 | |
| | Have employees passed an appropriate safety course? | | | | | 2 | |
| Chemical safety | Are employees aware of the safety of chemicals? | | | | | 3 | |
| | Are chemicals kept safely? | | | | | 2 | |
| | Are chemicals labelled regarding their safety hazards? | | | | | 2 | |
| Occupational health measures | Is there an adequate lighting source in the workshop? | | | | | 1 | |
| | Is the enterprise well ventilated? | | | | | 2 | |
| | Is the enterprise equipped with heating and cooling systems? | | | | | 1 | |
| | Is enough space provided in the workplace (3 square meters for each worker) ? | | | | | 2 | |
| | Do plant have a sufficient number of windows (lighting and ventilation) ? | | | | | 2 | |
| | Have the harmful agents present in the workplace been controlled? | | | | | 2 | |
| | Are ergonomic standards respected? | | | | | 2 | |
| | Is housekeeping respected? | | | | | 2 | |
| | Have workers been trained about occupational health issues? | | | | | 2 | |
| | Is there a bathroom at the site? | | | | | 2 | |
| | Is there water at the site? | | | | | 2 | |
| | Is garbage collected and disposed of correctly? | | | | | 2 | |
| | Have employees' annual health examinations been performed? | | | | | 2 | |
| | Is the enterprise equipped with a first aid box? | | | | | 2 | |
| | If necessary, does the workshop have safety and warning signs? | | | | | 1 | |
| Personal protective equipment | Do employees have access to personal protective equipment? | | | | | 3 | |
| | Do employees use personal protective equipment? | | | | | 3 | |
| | Is personal protective equipment standard? | | | | | 3 | |

more complete samples for these two industries.

Conclusion

Well-established occupational safety and health requirements have an important role in decreasing the occurrence of accidents and injuries. Based on the study findings, the overall SHRI score was categorized into the moderate level. Hence, feasible strategies such as providing basic training on job safety and occupational health aimed at the promotion of knowledge and awareness of employees about health and safety hazards in the working environment and taking appropriate protective actions such as establishment of regional occupational health agencies to render occupational safety and health services such as regular workplace inspections, periodic health check-ups, counselling, and suggestions about eliminating or minimizing work environment health and safety hazards may decrease the risk of accidents and injuries and promote occupational health and safety in the studied MSEs.

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